Types of Condensers

April 3, 2015 HgDinis25 Apparatus and Equipment Allihn, Bulb, Coil, Condenser, Davies, Dewar,Dimroth, Distillation, Femel, Friedrichs, Graham, Ground Glass, Hartzler, Jacketed, Liebig, Reflux, Triple-jacket

Introduction

In this post I'm going to discuss condensers. There is a wide variety of condensers out there, each one with specific qualities. For the Amateur Chemist it is important to own at least one, for general distillations and refluxes. However, funds to buy one may be low, so it's also important to choose wisely.

> Note: Before I go any further, let me remind you that this entire article is merely my own opinion. That includes the ratings of the condensers and the "What to Buy" section. Feel free to disagree or agree and to say so in the comments below.

Ground Glass Joints

Most condensers are now equipped with two ground glass joints (one male and one female). Condensers without ground glass joints are also available and are cheaper than those with ground glass joints. However, I strongly advise you to buy condensers that have ground glass joints. Why? Well, mostly because they allow you to get into complex setups with other ground glass pieces more easily. Also, condensers without joints will require rubber stoppers. These rubber stoppers get easily corroded with certain chemicals, spoiling whatever you're doing and destroying the stopper. In the long run, ground glass joints are far better than rubber stoppers.

Common Condensers

At the present time I only own two condensers. A 300mm Liebig condenser with only one ground glass joint and a 200mm Davies Condenser (two joints).

- **Liebig Condenser**

  Effectiveness in Distillations: ★★

  Effectiveness in Refluxes: ★★

Liebig Condensers are the most common condensers and the cheapest. They consist of an inner tube surrounded by an outer tube. The coolant flows through the outer tube and the substance gets condensed in the inner tube. It is only effective with substances that have boiling points of around 100ºC or higher. It can be used in distillations as well as refluxes.

Here is a picture of mine:

> Note: there is a condenser known as "West Condenser" that looks exactly like the Liebig Condenser. Story tells that the English changed the name Liebig (German name) to West because they didn't like the Germans.

- **Graham Condenser**

  Effectiveness in Distillations: ★

  Effectiveness in Refluxes: ★

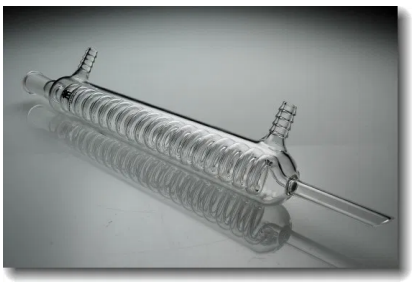
The Graham Condenser consists of an inner coil surrounded by an outer tube. The coolant flows through the outer tube and the substance condenses inside the inner coil. Graham Condensers should not be confused with Coil Condensers.

In my opinion Graham Condensers are useless. You can't use them for normal distillations because the condensed liquid doesn't flow to the receiving flask, ending up "clogging" the path. Then, pressure starts to rise in the apparatus, trying to push the liquid forward. This might make joints pop off or other sort of damage.

They can't be used in Refluxes either. Due to the narrow path of the inner coil, pressure rises too much and vapor starts shooting out from the top of the condenser. Explosions due to too much pressure have also occurred.

The only time they can actually be useful is in distillations where the condenser is held vertically. And, even then, they're not the best. They might be the best option when liquid nitrogen must be used as the coolant, though.

Picture: (from http://adamschittenden.com/uploads/tgeneral/Graham%20condenser%202.image.jpg)



- **Coil Condenser**

  Effectiveness in Distillations: ★★★

  Effectiveness in Refluxes: ★★★

The Coil Condenser is the reverse of the Graham Condenser. It consists of an inner coil surrounded by an outer tube. However, the coolant flows through the inner coil and the substance condenses inside the outer tube. This eliminates all the problems of Graham Condensers and gives the Coil Condenser a high efficiency.

Picture: (from http://www.camlab.co.uk/images/thumbs/0008785.jpeg)

- **Allihn Condenser**

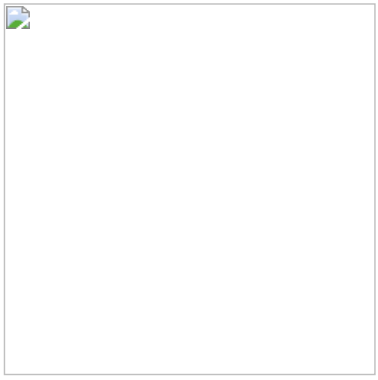
  Effectiveness in Distillations: ★

  Effectiveness in Refluxes: ★★★

Allihn Condensers consist of an inner tube (where the substance condenses), surrounded by an outer tube (where the coolant flows), just like Liebig Condensers. However, in the case of Allihn Condensers, the inner tube has a series of "bulbs". These bulbs increase the surface area of contact between the outer tube and the inner tube. Thus, they have good effectiveness.

Allihn Condensers are great for refluxes, but they can't be used in distillations (unless it is a distillation where the condenser is held vertically). This is because the substance would condense and get trapped in the side of the bulbs. Usually, they are the condensers seen being used with Soxhlet Extractors.

Picture: (from http://www.kavalier.cz/fota/shopub/300-1.jpg)



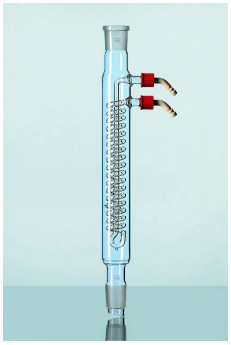
- **Dimroth Condenser**

  Effectiveness in Distillations: ★★★★

  Effectiveness in Refluxes: ★★★★

The Dimroth Condenser is similar to the Coil Condenser. However, the Dimroth Condenser, instead of having having just a coil, has a coil and a tube that runs in the middle of said coil. Dimroth Condensers belong to the more expensive category, but they have good efficiency and they are beautiful.

Picture: (from http://www.duran-group.com/uploads/pics/2425472sm_01.jpg)



- **Davies Condenser**

  Effectiveness in Distillations: ★★★★

  Effectiveness in Refluxes: ★★★★

Basically, the Davies Condenser consists of three tubes. The outer tube contains the other two. The middle tube contains the inner tube and is contained by the outer tube. The inner tube is contained by the medium tube. The outer and the inner tube have a connection. Coolant flows in the outer tube and the inner tube. The substance condenses in the middle tube. This design allows high efficiency when condensing substances, even with low boiling points.

Pictures of mine:

- **Jacketed Coil Condenser**

  Effectiveness in Distillations: ★★★★★

  Effectiveness in Refluxes: ★★★★★

The Jacketed Coil Condenser is similar to the Davies Condenser. The difference is that, instead of having an inner straight tube, the Jacketed Coil Condenser as a coil. The rest is the same. This makes the Jacketed Coil Condenser even more effective than a regular Davies Condenser.

Picture: (from http://www.scilabware.com/uploads/images_large/CX633SC.jpg)

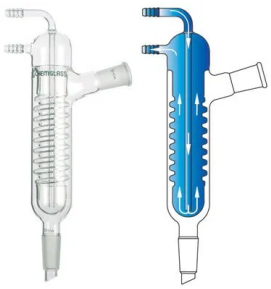
- **Friedrichs Condenser**

  Effectiveness in Distillations: ★★★★★

  Effectiveness in Refluxes: ★★★★★

There are many variants of the Friedrichs Condenser, like the one used in Rotavaps. Most of them are extremely effective. For some it is the best condenser out there. It is also one of the most expensive and, in most cases, it's just "overkill".

This is the actual Friedrichs Condenser (picture from http://chemglass.com/images_product_1/CG-1210.jpg):

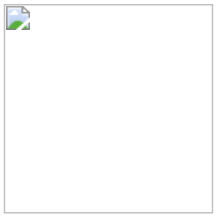


Not-so-common Condensers

- **Dewar Condenser**

The Dewar Condenser is a special type of condenser meant to be used with special types of coolants, in order to reach very low temperatures. Dry Ice/Acetone mixture is commonly employed. Instead of having the coolant circulating in it, it has a "container" where one can put the coolant (mostly solid coolants are used).

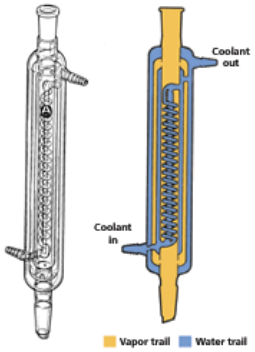
Some Pictures: (from http://www.atmarglass.com/xcart/images/T/Condenser-Dry-Ice-Dewar-Style.jpg and http://unitedglasstech.com/ugt2014onlinecatalog/Condensers/Conden74.jpg)



- **Triple-jacket Coil Condenser**

This condenser should be the description of "overkill". I believe it is exclusive from sigmaaldrich.

Picture: (from http://www.sigmaaldrich.com/content/dam/sigma-aldrich/chemistry/migrate4/Z422274.gif):



- **Hartzler Condenser**

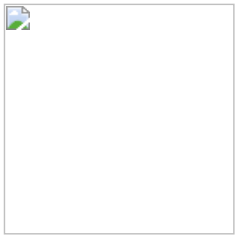
There isn't much information about this one. I believe it is used for refluxes and it's exclusive from sigmaaldrich.

Picture: (from http://www.sigmaaldrich.com/content/dam/sigma-aldrich/chemistry/migrate3/al_Z17588L.gif)

- **Femel Condenser**

Before you get any ideas, no, I do not know what the heck this is. But they can't get stranger than this so I'm finishing my list with the Femel Condenser.

Pictures:
(from http://viatest.com.br/novo_site/modules/rmms/uploads/ALAMBIQUE%20DE%20FEMEL%20CAPACIDADE%204000ml_frnJyWcR.jpg)



Which One to Buy

First of all, I only recommend buying condensers with ground glass joints. If I had known better I would have saved the money from the Liebig Condenser (only one joint) for later. It is simply not worth it. They may not be as cheap as the versions with one or without joints, but they certainly pay off in the long run.

> Note: On the following "discussion" I'm not even going to mention the Graham Condenser, for the reasons already explained previously.

So, which one is the best? I don't have a definite answer. Most Amateur Chemists out there want a good condenser for a low price. Thus, it is better to buy a condenser that is both good for refluxes and distillations. For this reason, I do not recommend buying an Allihn Condenser. They are not good for distillations.

I also wouldn't recommend a Liebig Condenser. They are cheap and will do the job 80% of the time. However, there is always those 20%, that include, for instance, volatile solvents, that you won't be able to do because you don't have a good enough condenser. Eventually, you will need to get a better one. It is cheaper in the long run to save some more money and buy one "for life".

So, we're left with the **Coil Condenser**, the **Davies Condenser**, the **Dimroth Condenser**, the **Jacketed Coil Condenser** and the **Friedrichs Condenser**. The Coil Condenser might not be as good as the Davies or the Dimroth, but it probably does the job 95% of the time. The Friedrichs is the king, but might be too expensive and a bit of "overkill" for the Amateur Chemist. Same goes for the Jacketed Coil Condenser. Honestly, any of those five condensers will serve you well. They might be a bit more costly but they do compensate for their price.

Where to Buy

I'm going to address this subject in a future post more deeply. However, in the case of Condensers it might be good to search for a Laboratory Glassware/Equipment company in your country. Some will sell to individuals. Of course you will probably have to pay extra for the postage of the item.

Ebay is also a good place to go. Sometimes you get great deals there.

Final Notes

This is an "extensive" list of the condensers out there. There are more designs out there. Some bizarre, some with only one or two purposes. If you think I omitted an important one feel free to say so. Please leave some comments and feedback. Hope this can help you out.